This Week's Citation Classic®

de Duve C & Baudhuin P. Peroxisomes (microbodies and related particles). *Physiol. Rev.* 46:323-57, 1966.
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The evidence supporting the identification of liver and kidney microbodies, and of similar particles present in *Tetrahymena pyriformis*, as centers of hydrogen peroxide metabolism (peroxisomes) is reviewed. The possible mode of biogenesis and biological functions of the new organelles are considered. [The *SCI*® indicates that this paper has been cited in over 820 publications.]

Birth of an Organelle

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This paper is the sister publication of a review on "Functions of lysosomes," published the same year in collaboration with Robert Wattiaux, also a *Citation Classic*.[1] Together, the two reviews wound up a long series of investigations that, in a little more than 15 years, had led to the biochemical and morphological characterization of two new cytoplasmic organelles, the lysosomes and the peroxisomes. Lysosomes were already well-established as digestive organelles at the time the two reviews appeared. Peroxisomes were younger. Their name, proposed only one year earlier,[2] reflected the association of type II oxidases, which produce hydrogen peroxide, with catalase, which destroys this substance (Figure 1). This H_2O_2-centered association of enzymes within specific particles had impressed us as biologically significant after we had recognized it in rat liver, in rat kidney, and in *T. pyriformis*.[3]

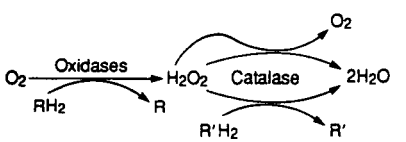

Figure 1: Schematic representation of peroxisome concept.

I wrote the paper with my Belgian collaborator Pierre Baudhuin, who had participated in much of the work that led to the characterization of peroxisomes. After reviewing the facts supporting the existence of peroxisomes as a separate group of particles, and the little that was known concerning their properties, we tried to address the problems of their biogenesis and of their functions. It was generally believed at that time that peroxisomes bud off from the endoplasmic reticulum (ER). This view was based on apparently convincing biochemical and morphological observations (which both turned out to be wrong). We adopted it and worked out a kinetic model based on the assumption that peroxisomes arise as buds from the ER, grow progressively up to mature size, fall off, and are eventually destroyed. The model was as wrong as the data on which it was built, but it had the advantage of inspiring specific experiments designed to test its validity. It took two PhD dissertations, by the late Brian Poole and by Paul Lazarow, to disprove the model and its premises, and to establish that newly synthesized peroxisomal proteins reach their host particles posttranslationally by way of the cytosol. Lazarow has since probed this mechanism in great detail with a number of collaborators.[4]

The last parts of our review were devoted to the biological functions of peroxisomes. It is typical of the scantiness of our knowledge that we even mentioned the hypothesis that peroxisomes might be "fossil organelles." We immediately rejected this possibility on evolutionary grounds, but were hard put to come up with possible functions for the few enzymes then known to be present in the particles. We did not suspect that a revolution lay just around the corner. In a few years' time, peroxisomes have reached the rank of major cellular organelles, widely distributed among all eukaryotes, including animals, plants, fungi, and protozoa. Their functions encompass the oxidation of all major foodstuffs, together with a variety of specialized processes, including transamination, lipid conversion to carbohydrate, cholesterol metabolism, plasmalogen synthesis, photorespiration, and bioluminescence. Uniquely inducible and adaptive, they have become favorite subjects of research in a wide spectrum of disciplines, from evolutionary biology to pathology.[5] The peroxisome, whose birth is recorded in this paper, has come of age.

1. **de Duve C & Wattiaux R.** Functions of lysosomes. *Annu. Rev. Physiol.* 28:435-92, 1966. (Cited 1,800 times.) [See also: **de Duve C.** Citation Classic. *Current Contents/Life Sciences* 28(7):16, 18 February 1985.]
2. **de Duve C.** Functions of microbodies (peroxisomes). *J. Cell Biol.* 27:25A, 1965. (Cited 55 times.)
3. **Baudhuin P, Müller M, Poole B & de Duve C.** Non-mitochondrial oxidizing particles in rat liver and kidney and in *Tetrahymena pyriformis*. *Biochem. Biophys. Res. Commun.* 20:53-9, 1965. (Cited 115 times.)
4. **Lazarow P B & Fujiki Y.** Biogenesis of peroxisomes. *Annu. Rev. Cell Biol.* 1:489-530, 1985. (Cited 85 times.)
5. **Fahimi H D & Sies H,** eds. *Peroxisomes in biology and medicine*. Berlin: Springer-Verlag, 1987. 470 p.

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